NB THIS IS NOT AN OFFICIAL PUBLICATION, IT IS SUPPLIED FOR INFORMATION, AND MAY NOT BE QUOTED IN PRINT.

September 1965

Met O 11 Technical Note - Number 19

An investigation into the association between strong to gale force easterly winds and surges in the Thames Estuary.

G. R. R. Benwell and J. F. Keers

Introduction

The investigation was conducted in two parts: the first was an examination of occasions over the last ten years when strong to gale force easterly winds affected the Thames Estuary and South East England to determine if there was any association between these occasions and recorded surges. The second part covered a larger period of time - the previous seventy years - and was concerned with the incidence of extreme easterly gales in an attempt to determine whether more extreme wind and surge conditions could occur than had been observed during the last ten years.

The Storm Tide Warning Service operates during the eight months covering the equinoxes and winter months, from September to April, and the investigation was confined to these particular months. The way in which the investigation was conducted was largely determined by the fact that it had to be completed in a very short time.

I. Association between strong easterly winds and the occurrence of surges in the Thames Estuary in the period September 1956 to April 1965.

1. Selection of occasions.

The DWR were examined and more than 200 occasions were catalogued when coastal stations in Southeast England from Yarmouth to Kent reported winds between 030° and 120° in direction and with speeds of 18 knots or more. In addition the hourly winds for the Isle of Grain were examined for all these days.

2. Definition of Surge.

The Storm Tide Warning Service maintains a log of occasions when surges affected the east coasts of Scotland and England: for this purpose a surge is regarded as having occurred when positive residuals of 2 feet or more are reported from two or more of the following five tide-reporting stations:- Aberdeen, Tyne, Immingham, Lowestoft and Harwich.

In order to determine the effect in the Thames Estuary it was necessary therefore to examine also the hourly records of the Southend Tide gauge - these were only available for the period from September 1962 to date.

3. Analysis.

From the occasions catalogued (more than 200) when the wind satisfied the conditions specified in paragraph 1, those when the wind strength was force 6 (22 to 27 kts) or more were selected for analysis.

There were 145 days when the wind strength at Gorleston reached force 6 or more from a direction between 030° and 120° and on 58 of these days the wind at the Isle of Grain also satisfied these conditions. These occasions were split into two categories corresponding to the wind directions 030-060, 070-120 and Table 1 lists these occasions according to wind strength and direction at both Gorleston and the Isle of Grain, and shows when surges were recorded by the Storm Tide Warning Service.

/TABLE I

TABLE I. Occasions with winds of force 6 or more at the Isle of Grain and Gorleston from a direction between 030 and 120° and any reported surges.

	FORCE 6 22-27 kts	FORCE 7 28-33	FORCE 8 34-40	FORCE 9 41-47
38 days at Isle of Grain 070-120	31	7	0	0
Occasions when Surges recorded by STWS	0	0	0	0
85 days at Gorleston 070-120	63	21	1	0
Occasions when Surges recorded by STWS	0	0	0	0
20 days at Isle of Grain 030-060	18	1	1	0
Occasions when Surges recorded by STWS	1 (25.2.58)	0	1 (19.1.63)	0
60 days at Gorleston for 030-060	41	15	3	1
Occasions of Surges recorded by STWS	0	1 (19.1.63)	0	1 (25.2.58)

Besides the surges on 25 Feb 1958 and 19 Jan 1963 there was another occasion - 16 April 1959 - when a surge was recorded with the winds not quite reaching force 6. On this latter occasion the surge was attributed to external causes and this was clearly seen to be true when the records from the other stations on the east coast were examined.

To find the effect at Southend graphs were plotted showing residuals at Southend, both the maximum and that at high water, for the 34 occasions when winds of force 6 or more from between 030 and 120 affected the Isle of Grain in (the 3 year period Sept 1962 to April 1965). These results are given in figure 1 and it will be noted that the high water tide was not raised by more than 1.8 feet in the 3 year period by these easterly winds, although there were 7 occasions where residuals of 2 feet or more were recorded. On one of these occasions - 19 Jan 1963 - a surge was recorded by the Storm Tide Warning Service and the maximum residuals of +3.9 feet and +4.8 feet were recorded at Southend and Tilbury respectively, four hours before the time of high water. No tide record are available for Southend for the other surge occasion which features in Table 1 - 25 Feb 1958 - but maximum residuals of +3.5 and +3.9 feet were recorded at Sheerness and Tilbury respectively and occurred at the time of high water.

The results presented in Table I suggest that a surge can occur in the Thames Estuary if a northeasterly gale is blowing there, or if strong northeasterly winds over the Thames Estuary are associated with severe northeasterly gales, not far away.

II. Survey of extreme easterly gales 1884-1954.

1. Definition of extreme easterly gales.

Extreme easterly gales were defined as gales between NNE and ESE affecting the area from Yarmouth southwards to Kent with the proviso that at least one station reported force 9 at some time during the gale.

2. Selection of occasions.

The monthly weather reports and annual summaries were examined and a catalogue was compiled of occasions when gales between NNE and ESE affected the east coasts of England from Spurn Head southwards: a few extra dates

/were

were obtained from Cdr Synnott's list of occasions with strong to gale force easterly winds on the east coast.

The Daily Weather Reports were consulted to determine the severity of the gales for the dates in this catalogue using the definition in paragraph 1.

There were only eight occasions in the period 1884-1954 when extreme easterly conditions affected southeast England and the Thames Estuary and these were

20 Feb 1888, 24 Nov 1895, 25 Mar 1898
18 Nov 1916, 7 Mar 1917, 17 Dec 1917
27 Dec 1927 and 29 Mar 1952.

3. Surges or high Tides.

It was not possible to obtain residuals for places in the Thames Estuary for these occasions, but the Storm Tide Warning Service maintains a file listing high tides which have been reported (in the literature, or the press etc.). Only one of the occasions of extreme easterly gales - 25 March 1898 - coincided with an occasion listed as having high tides. On this occasion the water level is noted as having reached about danger level at Sheerness.

An earlier occasion is referred to in the Meteorological Office Geophysical Memoir No.47 issued in 1929[1]. This was 18 Jan 1881 when extreme easterly gales were accompanied by flooding of the Thames: river levels had been running low since the season had been abnormally dry and the precipitation accompanying the storm was in the form of snow so there was no quick run off from frozen ground: the flooding must have been due to a considerable surge therefore.

More complete surge records exist for recent years and in the ten years covered by the first part of this investigation 1956-65 there were only two occasions which could be regarded as having extreme easterly gales, 25 Feb 1958 and 19 Jan 1963, and as noted in part I, there were residuals in excess of 2 feet on both occasions. On the 25 Feb 1958 there were easterly gales north of a depression which moved east over the Thames Estuary giving force 9 winds at Yarmouth (Gorleston): residuals of +3.9 and +3.5 were recorded at Tilbury and Sheerness respectively, both at high water. On 19 Jan 1963 during easterly gales in the Thames Estuary the mean hourly wind speed at the Isle of Grain reached 39 knots and the residuals at Southend and Tilbury were +3.9 feet and +4.8 feet respectively, four hours before high water.

4. The phase of the moon and the state of the tide.

The phase of the moon was obtained for each occasion from the dates of new moon available in Met O 13. This is given in Table II.

TABLE II. State of the moon and tide for occasions of extreme easterly gales in 1881-1965

Date	Phase of Moon	Neap or Spring Tide period
18. 1.1881	3 days after full moon	spring
20. 2.1888	7 days after new moon	neap
24.11.1895	5 days after new moon	neap
25. 3.1898	New moon	spring
18.11.1916	7 days after new moon	neap
7. 3.1917	2 days before full moon	neap
17.12.1917	2 days after new moon	spring
27.12.1927	3 days after new moon	spring
29. 3.1952	3 days after new moon	spring
25. 2.1958	4 days after new moon	spring
19. 1.1963	6 days before new moon	neap

Also noted in Table II is the state of the tide, whether spring or neap tide, on the assumption that the spring tide periods are from new moon till four days later and from full moon till four days later.

/Comments

Comments.

Extreme easterly gales are a relatively rare occurrence - only eight occasions being recorded in the period 1884-1954 and a further two in the last ten years: this corresponds to a frequency of about once a decade.

Since the number of occasions is so small and the number during spring tide periods is still smaller, little statistical significance can be attached to the fact that only one or possibly two occasions were associated with reported surges or flooding. Extreme easterly gales are apparently associated with raising of the water but further investigation is required to determine the extent to which the water level can be raised.

References:

1. Met. Office Geophys. Memoir No.47, 1929.
A. T. Doodson - Report on Thames Flood
J. S. Dines - Meteorological Conditions associated with High Tides in the Thames

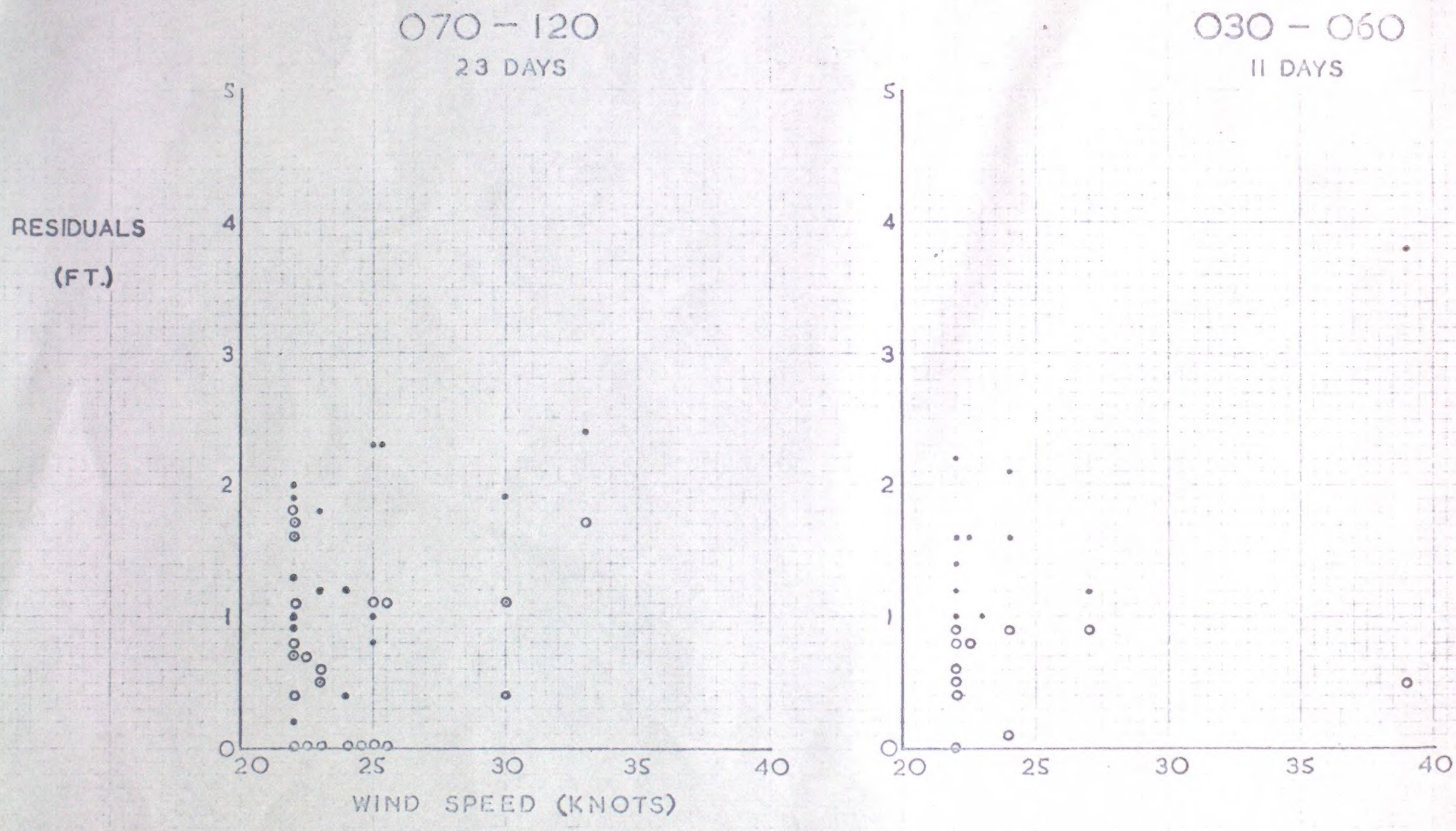

FIG 1. RELATIONSHIP BETWEEN RESIDUALS AT SOUTHEND AND WIND SPEED AT ISLE OF GRAIN

• Greatest positive residual at any time. ○ Greatest positive residual at High Water.